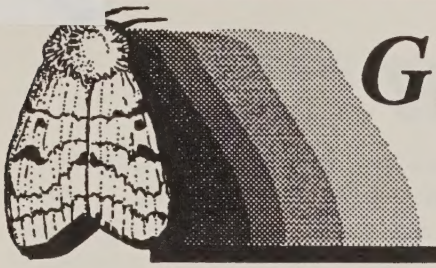


# GYPSY MOTH NEWS

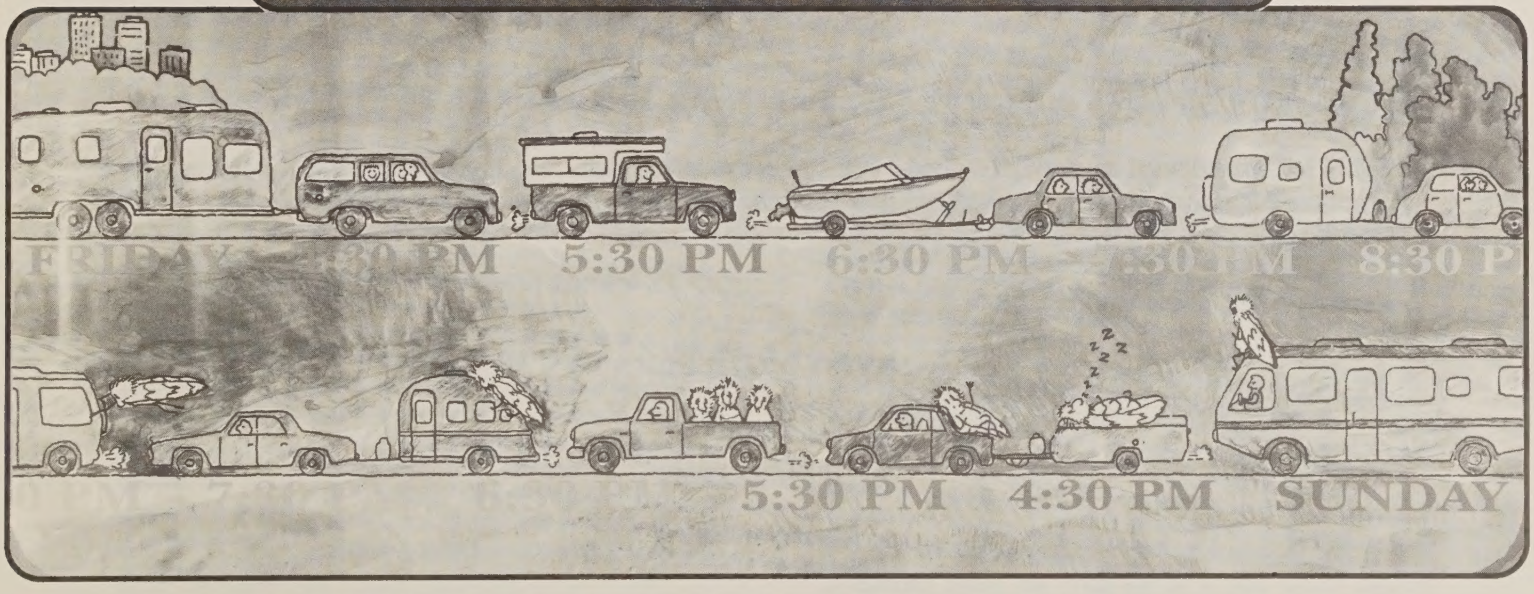
United States Department of Agriculture
Forest Service

NORTHEASTERN AREA
State and Private Forestry

June 1991
Number 26



## DON'T GIVE THE GYPSY MOTH A FREE RIDE




*Excerpted from a poster developed by Minnesota's Forestry Division, see page 2.*

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GYPSY MOTH NEWS is a service of the USDA Forest Service, Northeastern Area State and Private Forestry.

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Address correspondence to the Editor.

**GYPSY MOTH NEWS**

**Editor**
Daniel B. Twardus

**Managing Editor**
Helen A. Machesky

**Production**
Melissa A. Emerson

**Circulation**
Stephen C. Smith

USDA Forest Service
Forest Health Protection

180 Canfield Street
Morgantown, WV 26505

# EDITOR'S NOTE

The GYPSY MOTH NEWS is an information service. Part of that service will now include providing information about the Gypsy Moth Research and Development Program--its management, research, and new technology.

What is the Gypsy Moth Research and Development Program? Basically, it is additional money for accelerated research and development. This is not the first time the USDA has received additional money for gypsy moth research. The first accelerated research effort took place 1975-1978 and resulted in new technology including:

- mass-rearing technology
- the use of pheromones for monitoring, and
- the registration of Gypchek, a viral pesticide.

The current R&D program was begun in 1984. Dr. Max McFadden, Program Manager, Northeastern Forest Experiment Station, describes the focus of this effort as:

1) determine the effects of gypsy moth on forests;

2) increase the understanding of the biology and population dynamics of gypsy moth;

3) develop and evaluate management options; and

4) develop models and integrate knowledge.

Research within the Program is conducted through a competitive proposal process that has resulted in cooperative efforts with many institutions and agencies. You can find a list of them on page 29 of the Gypsy Moth Research and Development brochure mailed with this issue. The current list of funded extramural projects can be found on page 10 of this issue of the GYPSY MOTH NEWS.

What is current in gypsy moth research? If you look at the titles in the Gypsy Moth Research and Development brochure or the project titles in this issue, you will find:

- Natural enemies
- Host-plant relationships
- Population sampling
- Tree mortality
- Aesthetics/recreation
- Watersheds
- Hazard rating
- Decision making
- Microbials
- Microsporidia
- Models
- Expert systems

At some point, someone will sift through the publications and reports generated by this research and summaries will appear. It is through these summaries that we develop what we "know" about the gypsy moth and how to live and deal with it. Sometimes what we want to "know" changes. The view of ourselves or our environment changes and so what we want to "know" changes. Many of these project titles would not have been found in an R&D project 20 years ago--certainly not models and expert systems.

What will we want to know next year, or 5 years from now. This is the challenge of an R&D Program Manager--anticipating the need for knowledge so that the building blocks of that knowledge (those project titles that appear in this issue) are in place.

The research for this Program is coordinated through three Forest Service research work units:

1) Ecology and Management of Northeastern Forest Insect Pests. William Wallner, Project Leader, USDA Forest Service, 51 Mill Pond Road, Hamden, CT 06514.

2) Pathology and Microbial Control of Insects Defoliating Eastern Forest Trees. Michael McManus, Project Leader, USDA Forest Service, 51 Mill Pond Road, Hamden, CT 06514.

3) Silvicultural Options for the Gypsy Moth. Kurt Gottschalk, Project Leader, USDA Forest Service, 180 Canfield Street, Morgantown, WV 26505.

Please let these project leaders know if you have questions about the Program or if you would like to know more about the type of research being conducted.

--DBT

# ENHANCEMENT OF GYPSY MOTH MANAGEMENT, DETECTION, AND DELAY STRATEGIES

**Tom Eiber, Ph.D.**
**Minnesota Department of Natural Resources**
**Division of Forestry**
**St. Paul, MN 55106**

Recreational vehicles (RV's) travel freely, move often, and can easily carry several gypsy moth in life stages to uninfested areas. Summer camping is common in the Lake States region. Recreational vehicles from uninfested areas are commonly found in infested areas during times of larval activity and oviposition. These RV's then return home or move to a new area, potentially spreading gypsy moth as they go.

Gypsy moth is becoming more serious in the Midwest and threatens to rapidly infest new areas. The region shares a common recreational clientele and serves as a major receptor for RV's from infested urban centers outside the region. A new awareness project addresses the potential rapid expansion of gypsy moth on recreational vehicles via a program of awareness and voluntary inspection.

The program has been initiated by Minnesota's Forestry Division with the cooperation of the USDA Forest Service, Forest Health Protection Office in St. Paul, Minnesota. This project targets recreational users of forest areas since these user's are likely to move gypsy moths, particularly egg masses on their RV's. For example, Minnesota trailers are likely to be found in central Michigan during the oviposition times of July and August. Eggs can be laid on the undercarriage of the vehicle and hitchhike along when the vehicle moves. Most RV's sit idle beside homes or in storage lots during the egg hatching period in the month of May. As a result, potentially thousands of RV's could bring viable egg masses into uninfested areas each year. This might explain why Minnesota has been experiencing dramatic increases in male moth catches.

The objectives of the current awareness project are: 1) develop a regional strategy for dealing with recreational vehicle spread of the gypsy moth; 2) hold multi-state workshops on an annual basis in conjunction with the State Cooperators' Meeting or other regional pest workshops; 3) develop, print, and distribute recreationally-focused materials including a gypsy moth card, poster, and information sheet; and 4) prepare an educational-environment, awareness poster for distribution to schools for use in science and biology classes.

To date, two products have been produced for use with recreational clientele. The poster is large, colorful, eye catching, and action oriented. The Gypsy Moth Card color coordinates with the poster and carries the same text (see Figure 1). The card is customized for each cooperating State by adding the appropriate State logos and the State's gypsy moth information phone number if one exists. Production has included cards for Minnesota, Wisconsin, Michigan, Iowa, Illinois, Missouri, Florida, and a USDA Forest Service, Northeastern Area version. The objective of the campaign is to have owners look for and destroy egg masses. Both products contain high-quality color photos printed on a special five color press for accurate identification of the egg masses. They will be distributed to campers and campgrounds through the local State agencies already involved in gypsy moth work.

In addition to the movement of gypsy moth into adjacent regional areas (e.g., from Michigan to Minnesota where Minnesota RV's are the problem), this initiative has the potential to help States like Florida where much of the problem is being generated by RV's from infested areas coming to visit. A campaign in Michigan, for example, while targeted at RV's from uninfested areas (like Minnesota) would also access Michigan RV's which might travel to Florida in the winter. In this case, the problem is similar but with somewhat reversed roles.

Specifically, an infested RV from Michigan does not pose a significant threat in Minnesota since it is not likely to be camping in Minnesota when the eggs hatch in May. On the other hand, the same RV might arrive in central Florida in February. Eggs will hatch

quickly under these circumstances, and the rest is history. Obviously, an awareness program aimed at RV's and operated in the Lake States will benefit southern States as well.

The gypsy moth does not play fair in the game of Forest Infestation; thus, we must be aggressive. This program increases public awareness, generates active volunteerism, and promotes interstate cooperation. All products are available for use on a cooperative basis. For information, contact Tom Eiber, Minnesota DNR-Forestry, (612) 772-7567 (Voice) or (612) 722-7599 (FAX).

masses or other life stages after camping in infested areas.

Get into the habit of checking your camping equipment. DON'T GIVE GYPSY MOTH A FREE RIDE. For more information, or if you think you have found a gypsy moth, call your local forester, county agent, or agricultural agent.

MDA

INFORMATION:
296-3349 (metro)
or 800-652-9747
(ask for DNR-Forestry).

DON'T GIVE THE GYPSY MOTH
**A FREE RIDE**

The gypsy moth threatens to become a major tree pest in the Midwest in the 1990's. It eats leaves on most trees and may kill them. It is currently abundant in Michigan's lower peninsula and the eastern U.S. and Canada.

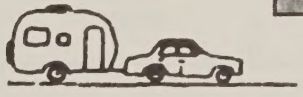
**INSIDE CARD**

*LARVA*

*PUPA*

*ADULT FEMALE*

DON'T GIVE THE GYPSY MOTH
**A FREE RIDE**



Don't help the gypsy moth move further west by giving it a free ride. The gypsy moth is usually spread to new areas by hitchhiking on outdoor articles. Although all life stages can hitchhike, it is usually the egg stage which is transported. Be sure to inspect your camper and other equipment for egg

**OUTSIDE CARD**

**FIGURE 1.--EXAMPLE OF MINNESOTA'S GYPSY MOTH CARD**

# COOPERATIVE USDA FOREST SERVICE-STATE GYPSY MOTH SUPPRESSION, 1991

| State/Site | Dimilin | B.t. | Other* | Total | |
|---|---|---|---|---|---|
| **DISTRICT OF COLUMBIA** | | | | | |
| National Capitol Parks East** | 0 | 125 | 0 | 125 | |
| **DELAWARE** | | | | | |
| Cooperative Suppression | 35353 | 6219 | 0 | 41572 | 42 |
| **MARYLAND** | | | | | |
| Cooperative Suppression | 59423 | 95231 | 0 | 154654 | 155 |
| Aberdeen Proving Ground** | 0 | 10270 | 0 | 10270 | |
| Andrews Air Force Base** | 0 | 1000 | 0 | 1000 | |
| Beltsville Agr. Res. Service** | 0 | 2133 | 0 | 2133 | |
| C & O Canal** | 0 | 81 | 108 | 189 | |
| Fort Meade** | 0 | 7554 | 0 | 7554 | |
| Greenbelt Park** | 0 | 332 | 0 | 332 | |
| Mt Vernon/GW Pkwy** | 0 | 320 | 0 | 320 | |
| NASA-Goddard SFC | 0 | 600 | 0 | 600 | |
| Patuxent Wild Ref Center | 0 | 3570 | 0 | 3570 | |
| Secret Service | 0 | 500 | 0 | 500 | |
| Suitland Parkway** | 0 | 132 | 0 | 132 | |
| **MAINE** | | | | | |
| Cooperative Suppression | 0 | 140 | 0 | 140 | 21 |
| **MICHIGAN** | | | | | |
| Cooperative Suppression | 0 | 208348 | 0 | 208348 | 208 |
| Huron-Manistee NF | 0 | 1618 | 0 | 1618 | |
| Wurtsmith AFB | 0 | 78 | 0 | 78 | |
| **NORTH CAROLINA** (Co-op eradication) | | | | | |
| Bert,Halifax,Northam | 0 | 7321 | 0 | 7321 | |
| **NEW JERSEY** | | | | | |
| Cooperative Suppression (Agr.) | 0 | 46927 | 0 | 46927 | 49 |
| Cooperative Suppression (For.) | 0 | 2200 | 0 | 2200 | |
| **NEW YORK** | | | | | |
| Seneca Indian Nation | 0 | 3815 | 0 | 3815 | |
| **OHIO** | | | | | |
| Cooperative Suppression | 1127 | 50 | 0 | 1177 | 1 |
| **PENNSYLVANIA** | | | | | |
| Cooperative Suppression | 105344 | 225181 | 0 | 330525 | 331 |
| Conemaugh Lake | 0 | 18 | 0 | 18 | |
| Cowanesque Lake | 0 | 102 | 0 | 102 | |
| Crooked Creek Lake | 0 | 283 | 0 | 283 | |
| Fort Necessity Park | 0 | 350 | 0 | 350 | |

# COOPERATIVE USDA FOREST SERVICE-STATE GYPSY MOTH SUPPRESSION, 1991 - continued

| State/Site | Dimilin | B.t. | Other* | Total |
|---|---|---|---|---|
| **PENNSYLVANIA** (continued) | | | | |
| Grey Towers | 0 | 101 | 0 | 101 |
| Mahoning Creek Lake | 0 | 55 | 0 | 55 |
| Raystown Lake | 0 | 925 | 0 | 925 |
| Tioga/Hammond Lake** | 0 | 453 | 0 | 453 |
| Tionesta Lake | 0 | 162 | 0 | 162 |
| Valley Forge** | 0 | 26 | 0 | 26 |
| Youghiogheny Lake | 0 | 38 | 0 | 38 |
| **UTAH** (Co-op eradication) | | | | |
| Wasatch Front*** | 0 | 29925 | 0 | 29925 |
| **VIRGINIA** | | | | |
| Cooperative Suppression | 58433 | 30254 | 0 | 88687 |
| Blue Ridge Parkway**,**** | 150 | 0 | 346 | 496 |
| Fort Belvoir | 2098 | 1708 | 0 | 3806 |
| Fredericksburg NB** | 0 | 230 | 0 | 230 |
| Great Falls/GW Pkwy** | 0 | 133 | 0 | 133 |
| Manassas NB** | 0 | 224 | 0 | 224 |
| Mason Neck Nat'l WR | 0 | 1366 | 0 | 1366 |
| Prince Wm. Forest Park** | 0 | 1000 | 0 | 1000 |
| Quantico Marine Base | 7004 | 7493 | 0 | 14497 |
| Quantico Nat'l Cemetery | 700 | 0 | 0 | 700 |
| Shenandoah Nat'l Park**,**** | 1166 | 0 | 200 | 1366 |
| Vint Hill Farms | 188 | 0 | 0 | 188 |
| Virginia S&PF**,**** | 22760 | 39746 | 671 | 63177 |
| **WISCONSIN** (Co-op eradication) | | | | |
| Wisconsin Eradication** | 0 | 5875 | 0 | 5875 |
| **WEST VIRGINIA** | | | | |
| Cooperative Suppression | 27658 | 496 | 0 | 28154 |
| George Washington NF**** | 0 | 2378 | 0 | 2378 |
| Monongahela NF** | 447 | 8854 | 160 | 9461 |
| West Virginia S&PF**** | 41576 | 15353 | 0 | 56929 |
| **GRAND TOTAL -- GYPSY MOTH TREATMENT** | **363427** | **771293** | **1485** | **1136205** |

* Other includes gypchek and disparlure.
** Double application of B.t. and/or Other.
*** Triple application of B.t.
**** Includes AIPM area.

NOTE: Second application is not reflected in the totals.

Data obtained from: National Pest Suppression Tracking System, Forest Health Protection, Morgantown, WV. (Revised 6/18/91)

# THE ROLE OF HAZARD RATING IN FOREST HEALTH PROTECTION

**Ray R. Hicks, Jr.**
**Professor of Forestry**
**West Virginia University**
**Morgantown, WV 26506**

The benefits derived from managed forests are often diminished by damaging "pest" organisms. Insects and diseases such as gypsy moth, oak wilt, etc., are examples of such pests. The current thinking regarding control of pests in extensively managed forests is to combine a broad array of tactics in an effort to shift the natural balance in favor of the host tree and prevent or deter a catastrophic outbreak of the pest. Such a system is called integrated pest management (IPM).

The key to implementing IPM is information--information regarding the status of the pest population in a given area, the condition and value of the forest, and the susceptibility and vulnerability of the forest to attack. Hazard rating deals with the latter two factors. My preference is to define the terms hazard and risk in a way similar to that used in fire management. For example, fuel loading over time produces an increasing fire hazard, but fire danger only occurs when the atmospheric and weather conditions are right (risk). Thus, an insect hazard may exist when site/stand conditions are conducive to a particular pest, but until pest populations build to damaging levels, the risk of loss is low.

Hazard rating allows the manager to prioritize activities. For example, when the susceptibility and vulnerability of a forest stand is known, actions such as pest population monitoring, silvicultural treatments and suppression activities can be targeted to the high hazard stands.

Furthermore, with information on forest condition and value, one may choose not to apply expensive treatments to stands of low value regardless of the hazard. Incorporating information on pest population levels provides a framework for decision making. Thus, the manager may choose to take action only in stands that are valuable, vulnerable, and have damaging levels of pests present.

Silvicultural techniques provide the manager with a unique opportunity to alter stand hazard. A sanitation thinning should reduce the hazard of a stand by removing the more susceptible and/or vulnerable trees. But here again, some assessment of the initial stand hazard is necessary in order to know which stands will benefit from such treatments.

Although hazard rating is a very useful and necessary component of an IPM system, managers must realize that, like any biological system, forests are complicated entities. Hazard rating systems are only as good as the information they are based on. When applying a hazard rating system, the manager should be sure the system used is compatible with their specific forest conditions. In the final analysis, the manager must judge as to whether ratings generated with a hazard-rating equation are logical. If the results seem erroneous, chances are, they are. At any rate, when such illogical results occur, one should look carefully at the conditions under which the hazard rating system was developed to see if they correspond to those under which the system is being applied.

In summary, forest hazard rating is a technique for identifying stands where pest damage is most likely. It can help the manager to prioritize actions, either to reduce hazard or suppress pests. But, as with most biological systems, forests are complicated ecosystems and managers must not abandon good judgment and logic in favor of a cookbook approach to management.

# GYPSY MOTH JAMBOREE

The 1991 Annual Gypsy Moth Review is scheduled for November 4-7, 1991, in Raleigh, North Carolina. If you are interested in attending, or would like further information, please call or write: W.A. Dickerson, Plant Pest Administrator, North Carolina Department of Agriculture, Plant Industry Division, Plant Protection Section, P.O. Box 27647, Raleigh, NC 27611. (Phone: 919-733-6930)

GYPSY MOTH RESEARCH AND DEVELOPMENT PROGRAM

NORTHEASTERN FOREST EXPERIMENT STATION

Technology Update

# GYPSY MOTH: SILVICULTURAL OPTIONS[1]

**Kurt W. Gottschalk**
**USDA Forest Service**
**Northeastern Forest Experiment Station**
**180 Canfield Street**
**Morgantown, WV 26505**

## CONSIDER IMPACT ON MANAGEMENT OBJECTIVES

Decisions about specific preventive or remedial actions will depend on individual land management objectives. A timber manager may not care about the expected loss of a few trees in an overstocked stand that would provide a natural thinning. But the recreation manager may have a very low tolerance for any mortality in an historic or scenic area. Wildlife managers might welcome small openings created by tree mortality, but would be concerned if too many mast-producing tree species were killed or defoliation resulted in a mast failure. The manager of wilderness lands might be indifferent to any natural tree mortality. By rating a forest stand's susceptibility to gypsy moth defoliation and vulnerability to tree mortality and other effects, managers can determine if impacts on their objectives are acceptable. If acceptable, then he or she might allow the infestation to develop unchecked. If not acceptable, some action might be considered.

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[1]Extracted from a paper presented at the Oak Resource in the Upper Midwest, Winona, MN, June 3-6, 1991.

## SELECTING ACTION ALTERNATIVES

Action alternatives available to the resource manager faced with gypsy moth-caused damage include silvicultural treatments, insecticide application, enhancement of natural control agents, low-level population treatments, or just letting nature take its course. The appropriate action depends on projected losses and their impact on management objectives. Silvicultural prescriptions are determined by the proximity of infestation, coupled with timber stand characteristics and maturity.

## SILVICULTURAL TREATMENTS

Silvicultural treatments have potential for reducing both susceptibility and vulnerability of forest stands (Gottschalk 1987). Alteration of stand susceptibility is achieved by: 1) maximizing tree growth and vigor, 2) manipulating gypsy moth habitat, and 3) increasing forest diversity. Alteration of stand vulnerability is achieved by : 1) maximizing tree growth and vigor, 2) removing high risk trees and stands, and 3) manipulating secondary organism habitat. The use of silvicultural treatments is very recent with most forest managers just accepting them as a management philosophy (Trew 1987). Despite this recent interest, silviculture will only be able to treat a small portion of the total area needing treatment within any given outbreak interval. Treatments need to be prioritized so that the most vulnerable and valuable stands are treated first.

If defoliation is not expected within the next 1-3 years, there is adequate lead time for taking preventive action. Seven silvicultural prescriptions have been described that may aid in reducing timber losses. If the stand is poorly stocked (less than C level; 35%), or if the stand is adequately stocked (C level or better; > 35%) but is within 5 years of maturity, stand regeneration may be considered.

Shortening the rotation will allow marketing of the current stand, avoiding lost value in the salvage of dead material, and assuring adequate regeneration through seed production and sprouting from live stumps. If advanced regeneration stocking and stump sprouting potential are adequate, the stand can be regenerated with a harvest. For stands where sources of regeneration are not adequate, a shelterwood or conversion cutting may be considered. If susceptibility or vulnerability of the stand is high, then conversion to nonpreferred host species will help reduce the establishment and spread of gypsy moth. On lower quality sites, conversion usually will be to a pine species, while higher quality sites can be converted naturally to mixed hardwoods by shelterwood or selection cutting. When susceptibility and vulnerability are low, shelterwood cutting can develop adequate advance regeneration; a drastic change in species composition is not needed.

If the stand is fully stocked but will not reach maturity for another 6 to 15 years, it is advisable to defer cutting for 6 to 15 years, and re-examine for possible protection, early harvest, or salvage if mortality has occurred. Younger fully stocked stands (16 or more years from maturity) with less than 80% stand density may best be handled by deferred cutting for 10 to 15 years and re-examining their status as defoliation becomes an immediate threat. Experience suggests that stresses created by thinning or cutting can remain for 1 to 3 years after treatment. Reduced vigor resulting from this stress, coupled with defoliation stress, could result in higher mortality. High-value, highly stressed stands should be observed closely and are good candidates for spray protection if an outbreak is expected during the recovery period.

For younger, fully stocked stands with more than 80% stand density, sanitation thinning or presalvage thinning may be considered, depending on the percentage of the basal area that is in preferred food species. Sanitation thinning is best applied in stands where less than 50% of stand basal area is in preferred food species, and where other management objectives make it appropriate. This treatment is designed to reduce the spread and establishment of gypsy moth by removing trees that are refuges and preferred food species. Presalvage thinning is best suited for stands with more than 50% of the basal area in preferred food species. This treatment reduces defoliation-caused losses by removing the most vulnerable trees before they are defoliated and die. Trees considered most vulnerable are oaks in poor crown condition, other species in poor crown condition, then trees with fair crowns. Trees with good crowns are less likely to die (Herrick 1982, Gansner and Herrick 1987b).

If defoliation is currently taking place or expected within the next 5 years, the appropriate actions are to protect with insecticide application, closely monitor and evaluate through stand examinations, or move ahead with stand regeneration plans. Priorities for insecticide application can be based on stand maturity, condition, and value; gypsy moth population densities; and management objectives. Under conditions of low stand value or low risk, the best course of action may be to delay treatment and re-examine the stand after defoliation to assess extent of damage, and salvage potential.

If defoliation has recently occurred, wait 1 to 3 years for any subsequent mortality. At that time, the stand can be re-evaluated to consider regeneration cutting (based on damage level and stocking condition); deferred cutting (as determined by stocking level, amount of damage, and stand maturity); and salvage cutting or thinning (again determined by stocking, stand condition, and damage level). A more complete guide for silvicultural treatment has been developed by Gottschalk.[2]

## PESTICIDE APPLICATIONS

Several approved insecticides, both synthetic and biological, are used as aerial sprays to control gypsy moth populations. These products give adequate control when used properly.

Most are applied when larvae are in very early developmental stages and when leaves are about one-third expanded. Pesticide and application costs vary by size of project, type of equipment, materials used, and terrain of the treated area. Total costs in 1990-91 ranged from $6 to $20 per acre for large

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[2]Gottschalk, Kurt W. Silvicultural guidelines for forest stands threatened by the gypsy moth. USDA For.Serv., Northeast. For.Exp.Stn., Gen.Tech.Rep. In Press.

areas. Additional information and assistance in planning spray projects can be obtained from local forest pest management offices.

## OTHER INSECT/BIOLOGICAL CONTROL ACTIONS

A number of other actions for low-level populations, eradication of isolated infestations, and introduction and release of biological controls are possible. Most of these actions are very expensive. Eradication of isolated infestations has been successful in most areas outside of the generally infested zone and expanding front. Low-level population treatments have had mixed success and high costs, but a couple of treatments are showing promise in recent tests. Enhancement of biological controls is valuable for introducing these agents into an area, but are too expensive to use for control of outbreaks. Many established parasites, predators, and diseases are moving with the gypsy moth as it moves, so introduction is probably not required.

## NO ACTION

Taking no action is sometimes the best choice. If projected effects of gypsy moth are not expected to affect management goals significantly, prudent managers may elect to take no action and "take their chances." Under these circumstances, no action probably is the most cost-effective option.

## CONCLUSIONS AND RECOMMENDATIONS

The gypsy moth has moved south and west from its original confines in New England and has spread out to infest about 25 percent of the Nation's hardwood forests. Repeated outbreaks have left its impact on all sections of the forest community. The pest has affected aesthetics, recreation, wildlife habitat, water yield and quality, and local timber markets. As the gypsy moth continues its invasion of new areas, new questions and concerns will arise. Information and guidelines presented here will provide forest managers with a better understanding of what to expect and serve as a basis for improved decisions for coping with the pest. One finding that deserves special mention is the great amount of variability in loss attributed to the insect. It follows that planning for cost-effective gypsy moth control programs should aim at forest stands most sensitive to heavy damage, with efforts made to identify such areas and hold damage to acceptable levels through silvicultural treatments.

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# GYPSY MOTH RESEARCH AND DEVELOPMENT PROGRAM

NORTHEASTERN FOREST EXPERIMENT STATION

## Funding Update

The following new and continuing projects were funded for fiscal year 1991. Additional information about these projects can be obtained by contacting Dr. Max McFadden, Program Manager, Northeastern Forest Experiment Station, 5 Radnor Corporate Center, 100 Matsonford Road, Suite 200, Radnor, PA 19087.

### FY 91 CONTINUING RESEARCH

| NO. | PRINCIPLE INVESTIGATOR AND INSTITUTION | TITLE |
|---|---|---|
| 1 | C. Wayne Berisford<br>University of Georgia<br>(Wallner)* | Performance of Gypsy Moth on Trees Indigenous to the Southern U.S.: Egg and Tree Host Phenology. |
| 2 | J. Burand/J. Elkinton<br>Univ. of Massachusetts<br>(McManus) | Detection of Latent Nuclear Polyhedrosis Virus in the Gypsy Moth. |
| 3 | Joe S. Elkinton<br>Univ. of Massachusetts<br>(McManus) | Developing a Gypsy Moth Monitoring System Based on Counts Under Burlap Bands. |
| 4 | Joe S. Elkinton<br>Univ. of Massachusetts<br>(McManus) | Nucleopolyhedrosis Virus Dynamics in Gypsy Moth Populations. |
| 5 | Gregory A. Elmes<br>West Virginia University<br>(Gottschalk) | Knowledge-Based Geographic Information System: A Component of the gypsES Project. |
| 6 | Ray R. Hicks, Jr.<br>West Virginia University<br>(Gottschalk) | Impact of Gypsy Moth Defoliation on Hydrology and Water Quality in North-Central West Virginia. |
| 7 | Ray R. Hicks, Jr.<br>West Virginia University<br>(Gottschalk) | Evaluation of Hazard Rating and Silvicultural Treatments to Minimize Gypsy Moth Impacts on the West Virginia University Forest. |
| 8 | S. Hollenhorst/S.Brock<br>West Virginia University<br>(Gottschalk) | Effects of Gypsy Moth Defoliation on Public Outdoor Recreation Area Visitation and Public Opinion Regarding Gypsy Moth Suppression. |

| | | |
|---|---|---|
| 9 | James E. Johnson<br>VPI & SU<br>(Gottschalk) | Impacts of Gypsy Moth Defoliation on Mixed Pine-Hardwood Stands in Virginia. |
| 10 | J.A. Logan, D.R. Gray,<br>F.W. Ravlin<br>VPI & SU<br>(McManus) | Development of a Predictive Model of Gypsy Moth Egg Phenology |
| 11 | Jesse A. Logan<br>Janet M. Fehringer<br>VPI & SU<br>(Gottschalk) | Refinement of the Gypsy Moth Phenology Model Using Field Data |
| 12 | J.V. Maddox/Jeffords<br>Illinois Natural History<br>Survey<br>(McManus) | Interactions Among Microsporidia of the Gypsy Moth |
| 13 | James B. McGraw<br>West Virginia University<br>(Gottschalk) | Interaction of Natural Levels of Environmental Stress and Defoliation on Oak Survival, Photosynthesis and Growth. |
| 14 | David R. Miller<br>D.E. Anderson<br>Univ. of Connecticut<br>(McManus) | Evaluation of Micrometeorological Influences Critical to Aerial Spraying in Hardwood Forests. |
| 15 | Bruce L. Parker<br>University of Vermont<br>(Wallner) | Gypsy Moth Management in Foci. |
| 16 | F.W. Ravlin<br>VPI & SU<br>(Gottschalk) | A Knowledge-Based Environment for Decision Support in Gypsy Moth Management-gypsES: Monitoring, Prediction, and Data Base Management. |
| 17 | F.W. Ravlin/Fleischer<br>VPI & SU<br>(McManus) | Development of a Gypsy Moth Population Monitoring System: Sampling Egg Masses in IPM Programs. |
| 18 | M.Saunders/M.Foster<br>Penn State University<br>(Gottschalk) | Development of Knowledge Based Treatment Decision and Implementation Advisors: Two Components of the gypsES Project. |
| 19 | Philip Wargo<br>NEFES, Hamden, CT<br>(Gottschalk) | Relate Abundance of Rhizomorphs of Armillaria in the Soil to Abundance on Crop Trees and Subsequent Mortality After Defoliation. |
| 20 | Joseph W. Wilder<br>West Virginia University<br>(Gottschalk) | Factors Contributing to Dynamics of Gypsy Moth Populations in the Gypsy Moth Life System Model. |

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|---|---|---|
| 21 | John Witter<br>University of Michigan<br>(Wallner) | The Effects of Host Tree Phenology and Host Switching on the Gypsy Moth. |

## FY 91 NEW RESEARCH

| NO. | PRINCIPLE INVESTIGATOR AND INSTITUTION | TITLE |
|---|---|---|
| 1 | Donald H. Dean<br>Ohio State University<br>(Slavicek) | Gypsy Moth-Specific Bacillus thuringiensis and -endotoxins: Improvement by Site-Directed Mutagenesis. |
| 2 | Joe S. Elkinton<br>Univ. of Massachusetts<br>(Slavicek) | Predicting the Spread of Engineered Virus |
| 3 | Fred P. Hain<br>North Carolina State Univ.<br>(Yates) | Impact of Small Mammal Predation on Gypsy Moth Populations on Selected Habitats of the Southeast. |
| 4 | Ray R. Hicks, Jr.<br>David E. Fosbroke<br>West Virginia University<br>(Gottschalk) | Susceptibility and Vulnerability of Mixed Oak Clearcuts to Gypsy Moth. |
| 5 | Michael E. Hohn<br>WV Geological & Economic Survey (Gottschalk) | Geostatistical Models for Forecasting Gypsy Moth Defoliation |
| 6 | Richard L. Lindroth<br>University of Wisconsin<br>(Wallner) | Interactive Effects of Foliar Ascorbic Acid and Phenolics on the Gypsy Moth (Lymantria dispar). |
| 7 | K.Mierzejewski/W.Yendol<br>Penn State University<br>(McManus) | Studies in Aerial Application Technology Relating to the Improvement of Suppression of the Gypsy Moth. |
| 8 | G.Simmons/M.Scriber<br>Michigan State University<br>(Wallner) | An Efficient Egg Mass Survey Method for Forests and Suburban Areas |
| 9 | Cynthia Walter<br>St. Vincent College<br>(Gottschalk) | Soil Nutrients and Small Tree Growth Before and After Gyspy Moth Arrival in Southeastern Pennsylvania. |
| 10 | A.Wood/J.Elkinton<br>Boyce Thomp./UMass<br>(Slavicek) | Field Release of a Genetically Marked Lymantria dispar Nuclear Polyhedrosis Virus ILdNPV. |

*Technical contact for each of the agreements.

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